USE OF SCATTEROMETRY FOR NXE:3100 SCANNER MONITORING

A. Charley*, J. Hermans, S. Cheng

*contact: charley@imec.be

Two monitoring wafers are exposed daily on the NXE:3100 EUV scanner at imec to monitor and characterize its performance. For a good control of the tool, these wafers also have to be measured and characterized daily. It is now well recognized that, once a recipe is thoroughly optimized and setup for a given process and feature, scatterometry is a very powerful technique for monitoring purposes: it can provide rapidly with precise measurements.

In this paper, a study on the use of scatterometry for NXE:3100 scanner monitoring is performed. A recipe optimized to measure 27nm 1:1 lines is carefully characterized and compared to our reference metrology CD-SEM in terms of variations with dose and focus and variations across field and wafer. Finally long term monitoring data done in parallel with CD-SEM and scatterometry is reported.

Daily monitor conditions:

NXE:3100 scanner/Lithius Pro track

NA=0.25 and σ=0.81

SEVR140-50 nm on AL412-20nm

Target: CD on mask 27 nm Pitch 54 nm, vertical and horizontal

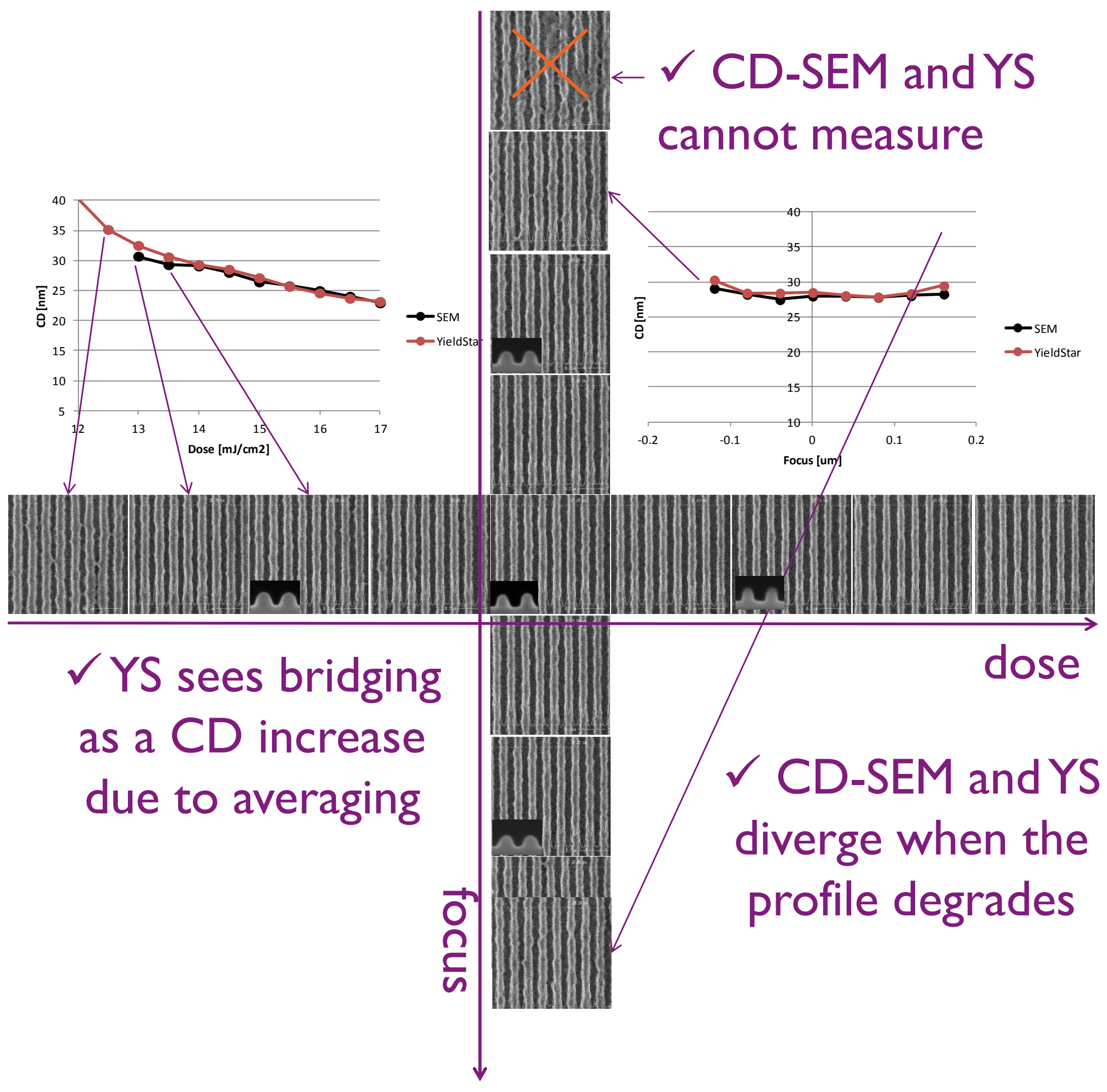
Sampling: 5x3 for across wafer and 24x6 for across field

Metrology:

ASML YieldStar S200

Hitachi CG-4000 and CG-5000

Through focus and dose characterization:

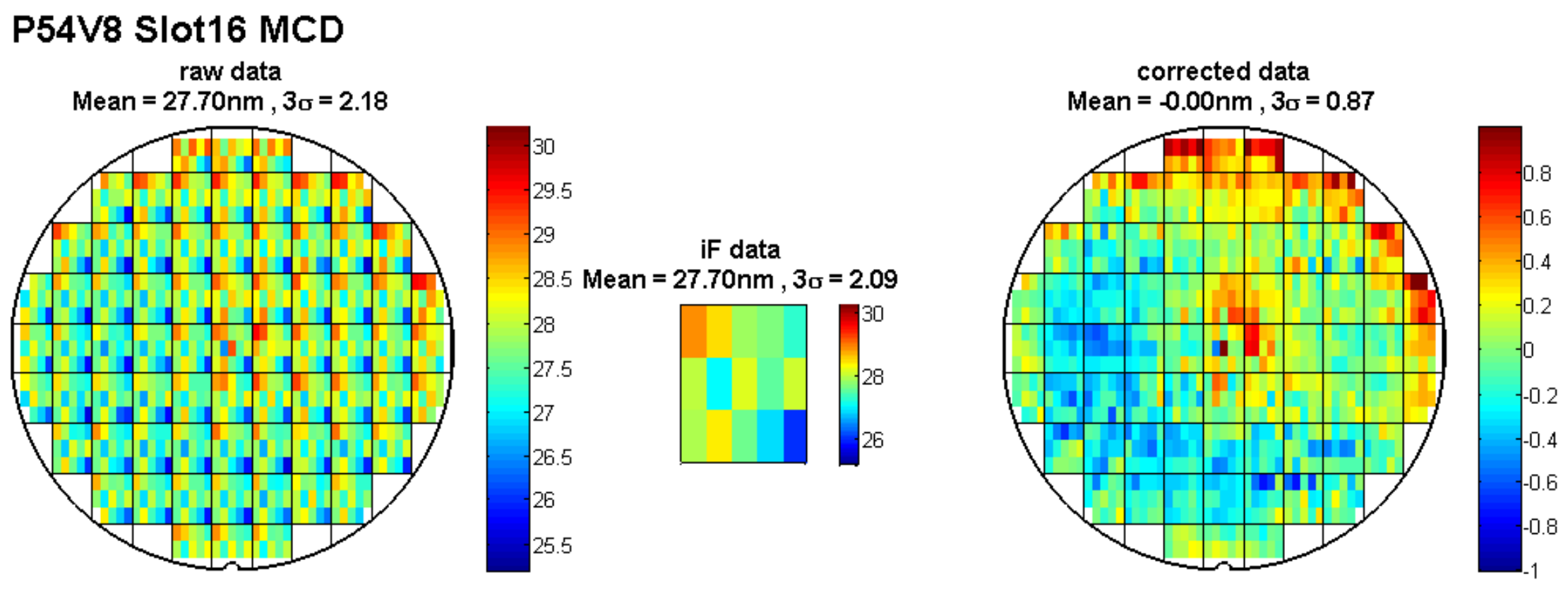


✓ CD-SEM and YS cannot measure

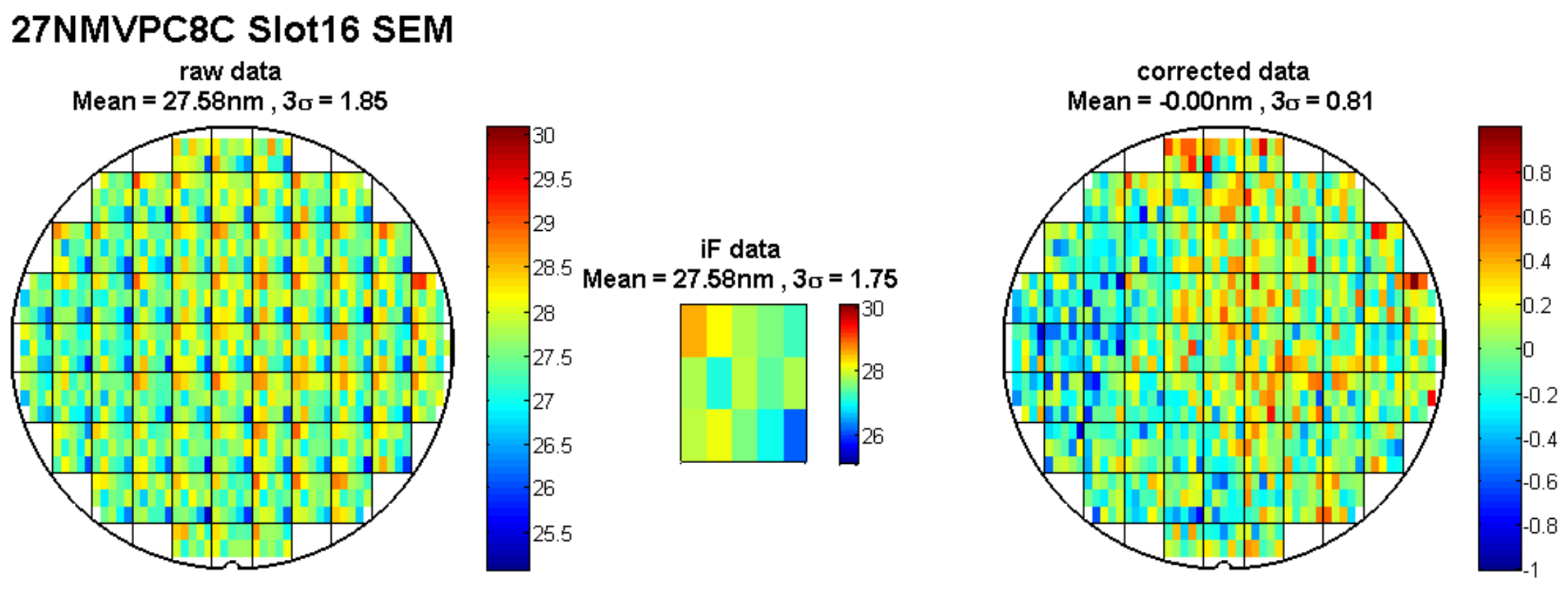
✓ YS sees bridging as a CD increase due to averaging

✓ CD-SEM and YS diverge when the profile degrades

Across wafer characterization:

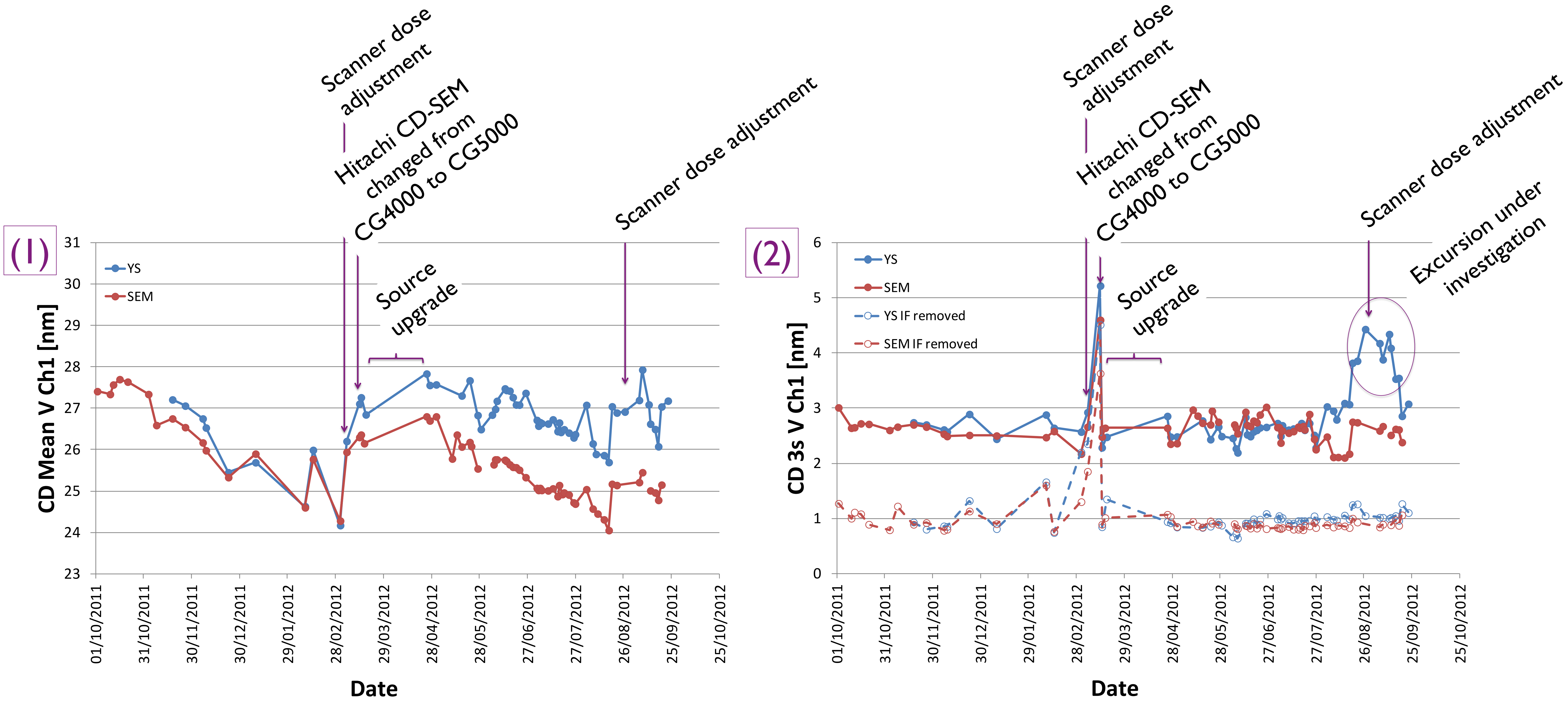


YieldStar CDU map:
across wafer, averaged intrafield, across wafer after intrafield removal



CD-SEM CDU map:
across wafer, averaged intrafield, across wafer after intrafield removal

Because of correlation between floating parameters (underlayer "UL" thickness and MCD), UL thickness has to be fixed. This recipe provides with very comparable response to the reference metrology for NXE:3100 monitoring, CD-SEM, both in terms of mean values, response to dose and focus variations and across wafer and field fingerprint.



1 year NXE:3100 monitoring data measured with CD-SEM and YieldStar: Mean CD (1) and 3σ CDU (2), vertical, target chuck 1
(Note: Horizontal orientation is also monitored daily and shows same consistency with CD-SEM)

A thorough characterization of the scatterometry recipe allowed us to show: a good match with CD-SEM in the response to dose and focus changes within the process window as well as a reasonable CDU fingerprint match with CD-SEM, our reference metrology for NXE:3100 scanner monitoring. Long term monitoring data done in parallel have proven the capability of YieldStar to monitor EUV 27nm 1:1 L/S accurately as long as we are not faced to too large scanner excursions (out of process window). This long monitoring dataset has grown our confidence in scatterometry for EUV monitoring. Furthermore, YieldStar has the advantage to provide rapidly with a highly sampled CDU (8.3 vs 1h for SEM for 1 orientation, 1 wafer, 5x3 points per field). However, for trouble shooting, CD-SEM needs to be used in parallel as long as the scanner has not reached a stable state.